It is to be remarked in this connection that when the absolute pressure at the Azores is higher than the average, and at the same time the absolute pressure at Iceland is below the mean as happens in more than 70 per cent of the cases, then in consequence of the gradient over the North Atlantic being greater than the normal the atmospheric machine works more actively and the warm oceanic winds from the west sweep over western and central Europe. Conversely, when the pressure at the Azores is reduced, and the pressure at Iceland increased at the same time as is generally the case, then the pressure gradient from south to north is weakened or even reversed, and the moderating influence of the Icelandic low on the climate of northwest Europe diminishes or even disappears.

It is to be observed that there may be large positive or negative departures of temperature in central Europe without the pressure at Stykkisholm being either high or low: e. g., the radiation winter 1879–1880, when clear, cold weather prevailed, had low pressure in Iceland, but the pressure was also low at Ponta Delgada.

The cases in which the pressure at the Azores is increased while that in Iceland is reduced are theoretically the most interesting. On the contrary, if the pressure at the Azores is lower and that in Iceland is higher this may be due and often is so, as in the winter of 1880–81 to a displacement of the anticyclone to the north, and at such times no theoretical reasoning can be based on the apparent gradient from the Azores to Iceland. However, when the pressure at the Azores is unusually high this can not well be considered as a simple displacement of the subtropical anticyclone, but only as a greater intensity of it owing to increased activity of the atmospheric circulation.

When the northeast trade blows much stronger than usual this will tend to increase the barometric maximum on its right hand. This will increase the atmospheric whirl over the North Atlantic Ocean and thereby the pressure minimum at its center near Iceland will be deepened.

The increased pressure at the Azores and the deepening of the minimum over Iceland which is connected therewith may thus be related to each other as cause and effect. This consideration imparts more theoretical interest to the circumstance above demonstrated, that decided positive pressure departures at the Azores occur together with negative ones in Iceland. That the probability of this relation only reaches 70 to 80 per cent may be attributed to the fact that the reasoning is based on the pressure conditions at two fixed points in consequence of which lateral displacements of the central areas of high or low pressure may easily produce apparent exceptions.

It is only isobaric maps of the Atlantic Ocean that can give the true key to all cases. In order to study these for 50 years it will be necessary to have 600 monthly maps; it will be fully 20 years before the "Hoffmeyer Charts" have reached that age and even then it will be found that the most convenient and shortest expression for the gradient over the North Atlantic Ocean will be afforded by the difference of pressure between the two stations of Ponta Delgada and Stykkisholm.—*E. R. Miller.*

THE SUGAR BEET AND ITS CLIMATIC ENVIRONMENT.

The Bureau of Chemistry has just published Bulletin No. 95 "The Influence of Environment upon the Composition of the Sugar Beet". This is in continuation of previous Bulletins Nos. 64, 74, 78, on the same subject, and represents the results of the fourth year of the study. Eleven stations including that at Washington, D. C., have been considered, viz: The Agricultural Experiment Stations of Colorado, Fort Collins; Iowa, Ames; Indiana, Lafayette; Kentucky, Lexington; New York, Geneva and Ithaca; Oregon, Union; Wisconsin, Madison; Wyoming, Laramie.

At all these stations a uniform variety of beet was furnished from the Bureau of Chemistry with fairly uniform directions as to sowing and cultivation. Samples of the soils were sent to the Bureau for analysis, and complete meteorological data were tabulated. About a month prior to the usual time of harvest in the respective localities a sample harvest of 25 beets was gathered and forwarded to the Bureau of Chemistry. This sampling was repeated weekly until the frost prevented further operations, or the beets began to deteriorate. In some cases irrigation was practiced, alongside of other experimental plats which had no irrigation.

At the Washington station, on the Potomac flats, the soil on which the beets were grown had been made artificially by dredging the channel of the Potomac River.

At the end of the Bulletin Doctor Wiley summarizes the conclusions from which we take the following notes as to the influence of the climate:

> In general it will be seen that the content of sugar in the beet varies with latitude, the lowest sugar content in the lowest latitude and vice versa. While, as is to be expected, there are variations in this curve, the general statement that the content of sugar rises as the latitude increases is again established. There is a less definite relation between the hours of sunshine and the sugar content of the beet. Inasmuch as it is generally conceded that the formation of sugar in the plant is a function which is largely influenced by light and can not be conducted without it, it seems only reasonable to suppose that the greater the quantity of light the greater the quantity of sugar developed. It is evident, therefore, that as the latitude increases the number of hours of light increases, thus giving the plant laboratory a longer working day. It has also been pointed out that light is more important than clear sunshine, since those radiations of the sun which are most active in stimulating the cellular activity of plants seem to suffer no marked diminution of power in passing through strata of aqueous vapor. The number of clear days varies greatly at different stations; the lowest number was at Ithaca: Washington, Lexington, Lafayette, and Ames all had a very large number of clear days in proportion to the number of days in the month.
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> * * * There is an intimate relation between the percentage of sugar in the beet and the length of the day. * * * The purity of the beets bears a very close relation to the quantity of sugar. * * * The temperature of the air varies inversely as the sugar content of the beet being highest when the sugar is lowest and lowest where the sugar is highest. * * * There is a general agreement between the percentage of sugar in the beet and the altitude of the station, but this agreement is not uniform, and it is evident that the only effect of the altitude will be found in diminishing the temperature, and that otherwise it can not have any possible effect upon the composition of the beet. There is an apparent relation between the amount of rainfall and the sugar content, the curves rising together, but this may be regarded as an indication of no value, but rather as accidental, and, moreover, there are wide and violent variations from the general agreement. The distribution of rainfall appears to have had no direct effect upon the content of sugar in the beet. It is evident, however, that there might be such a distribution of rainfall as to influence unfavorably the sugar content, and this has been pointed out in the discussion of the data of the various stations. There would be undoubtedly a tendency of the rainfall to diminish the sugar content if it should be so distributed as to restrain the normal growth of the beet during the growing period, especially in August, or to unduly stimulate it by excessive rainfall during the period when ripening would naturally take place, as in September and October. A number of instances of this kind have already been pointed out.

As Professor Wiley seems to have satisfactorily demonstrated by four years of special study in this country (confirming many years of experience in Europe) that the beet, like the cabbage and probably other plants, increases the sweetness of its juice in proportion as it is grown in more northern latitudes, it is natural at first thought to attribute this to the coldness of the climate or to the increase in length of the day and consequently in the total amount of sunshine during the growing period. But if we analyze the matter carefully, we shall see that it is probably not the temperature of the air as such or the length of the day as such that is important. So long as the temperature is above freezing and the surrounding air is moist the action of the sunlight and of the diffuse sky light stimulates the chemical changes that are going on within the leaf. Even the faint twilight or the blue light that simmers down through a leafy forest, or the fractional part of daylight received by an object in the shade, is sufficient to maintain these chemical changes; strong daylight is usually not essential, and the final result depends more on the duration of the gentle twilight than on its intensity. In fact, such changes may go on under artificial light that is far less intense than the ordinary daylight. The amount of light received by a horizontal surface in the open air when the sun is 20° above the horizon, as during the arctic summer, is almost equally divided between the direct light of sunshine and the diffuse light of the sky; the amount received by a leaf of a plant will depend upon its aspect, and it may easily receive more from the sky than from the sun. We must, therefore, believe that as the storage of sugar within the beet root must depend originally upon its manufacture in the leaf, and as the quantity diminishes with temperature, the manufacture and the storage both depend essentially on the *duration* of the chemical action of skylight and sunlight upon the juices of the leaf; this must be the reason why the beet is sweeter in proportion as it is grown in northern latitudes. From this point of view we see why it is that nothing but excessively thick clouds and rain cut off enough sunshine to materially affect the sweetness of the beet, since those waves of light that are most active in stimulating the formation of sugar pass quite freely through ordinary moist air and thin clouds.

The temperature of the air is often confounded with the temperature of the soil. This latter temperature depends so much on the loss of heat from the surface of the earth by radiation through a clear sky that we are apt to forget that the soil may be very cold all day long at a few inches depth, while the surface of the ground is warmed up by a few hours of direct sunshine. Clear blue sky does not warm up the soil although it does exert a stimulating influence on the leaves of plants. If warmth is injurious to the sugar content of the beet as these investigations seem to show, then it becomes important to ascertain by experiments in mulching whether it is the warmth of the soil or the warmth of the leaf that is objectionable. In the mountainous parts of France it is a common experience that irrigation with very cold water from the glaciers retards greatly the growth of wheat and other grains, while it favors the growth of some grasses, many of which grow at temperatures near freezing. By analogy we might infer that the temperature of the irrigation water used in beet fields would be a matter of importance. At any rate the investigation of the beet root and its environment requires that we should study very carefully the temperature of the soil down to the lowest end of the tap root.

WEATHER BUREAU WORK DURING THE ECLIPSE OF AUGUST 30, 1905.

The U. S. Naval Observatory having organized an expedition for astronomical work during the eclipse of August 30, the U. S. Weather Bureau was invited to carry out the meteorological work. The details of the necessary organization were entrusted to Prof. Frank H. Bigelow who, with his assistant, Mr. Stanislav Hanzlik, left Washington about June 14 and 18, respectively, and with others, sailed from Norfolk in the U. S. transport *Cæsar*. The astronomers of the party left New York on the U. S. S. *Minneapolis;* supplies and instruments were sent on the U. S. S. *Dixie*.

Under date of July 28, near Tortosa, Spain, Professor Bigelow writes as follows:

The *Dixie* arrived at Gibraltar July 6, the *Cæsar* July 7, and the *Minneapolis* July 17. I was then transferred to the *Minneapolis* by Admiral Chester. We all sailed from Gibraltar July 19, the *Dixie* with Mr. Hanzlik and his equipment direct to Bona, where he is to establish our three African stations. He now understands my plans fully and I believe he will do the work properly. It had been my intention to go there from Valencia as soon as my Spanish stations were in order, but the *Minneapolis* sails July 28, on its course, Valencia, Bona, Lisbon, Cadiz, Gibraltar, returning to Valencia by August 17, so that I can not go that way, and I know of no other transportation from Valencia to Bona. I shall have to leave Mr. Hanzlik to do his duty as well as he can by himself. Captain Norris, in charge, will assist him with the organization.

The *Cæsar* and *Minneapolis* arrived at Valencia July 21. Several days, Friday to Monday, were consumed in making trips of exploration to settle upon the sites of the astronomical stations and finally Daroca is chosen for the central station and Porta Coeli for that near the southern edge of the track.

The boxes went ashore Monday afternoon, July 24, and while the transfer and preliminary work was being done by the astronomers, I located my instruments for two secondary stations. One I have placed at Castellon in the Institute. The other I have established in the Solar Physics Observatory of the Ebro, about two miles distant from Tortosa, where I am writing this note.

Admiral Chester has given me enough men for the primary stations and I am arranging with the people here for the secondary stations. At Castellon I paid a small sum for the work and set up our own instruments. They took meteorological observations there 20 years ago, but had abandoned them. At Tortosa they have a splendidly equipped observatory on the very plan that we are developing at Mount Weather and they will give me a copy of their observations for 40 days for $10. This plan is cheaper for the Government than the other one of sending and maintaining our naval officers and men.

To-day (July 28) I return to Valencia, thence to Porta Coeli to organize the work there, then to Daroca to put that station in order, then to Zaragoza where I have already secured my observer, then to Guadalajara or Madrid, and finally I will return to Daroca for my own share in the eclipse.

The meteorographs were fully revised or repaired at Gibraltar and the *Cæsar* will call there to take on the kites which I have urgently requested to be sent.[1]

On the return homeward the *Cæsar* will sail from Valencia, September 5, for Nice, and thence September 13, and should arrive in Hampton Roads about October 5.

It will not be possible for me to attend the meeting of the International Meteorological Committee at Innsbruck, Austria, which will not get under way until September 11. However, I shall have from September 2 to September 13 to myself and propose to go to Paris, Potsdam, Brunswick, and Munich on my way to Nice.

At this Observatory of the Ebro they are organized as it should be. It is under the order of the Jesuit Fathers, and they have about ten highly educated, well trained men, each one responsible for a line of work, and all under one scientific director, Cirera. It is the only possible policy for success, this is inexpensive for them and the priests get no salaries; they are supported by wealthy Catholics.

Tortosa is in the eclipse track and it will carry off the honors in solar physics this time.

Under date of August 10, Professor Bigelow writes from Madrid, as follows:

The primary astronomical station near the southern edge of the shadow is located at Porta Coeli, about seven miles from Betera to the north, this being twelve miles west of Valencia. It is placed in the grounds of the old convent, not in use at present, except in an irregular way by visitors during the summer. The site is admirable and the climate all that could be desired. The work is in charge of Professor Littell, assisted by Peters, Anderson, and Hill, with numerous helpers. At the time of the eclipse the party will be increased to about forty persons by details from the U. S. S. *Minneapolis*, which is at present cruising to Bona, Algiers, Tangier, Lisbon, and Gibraltar, returning to Valencia about August 17.

My observatories have been running steadily since about August 3. The trio of stations, Porta Coeli, Castellon, and Tortosa, is strongly affected by the sea breeze and as the total eclipse occurs in the midst of the local convection it will be interesting to try to separate the effect of the shadow proper from it. The other three stations, Daroca, Zaragoza, Guadalajara, are too far inland to feel this wind from the sea and the contrast between the curves for the two sets of stations ought to be instructive.

At Daroca, near the central line, the astronomical station is being established with Professor Eichelberger in charge and Mitchell, Yowell, and Hoxton with several others in cooperation. I have placed more of my instruments at Daroca than at Porta Coeli, intending to return

[1] Five new kites, with extra fixtures and materials for repairs, etc., and with improved attachments for kite meteorographs were sent Professor Bigelow, August 10, 1905, by express, in care of the American Consul at Gibraltar, and it is hoped these will reach him in time to be used on the return trip across the Atlantic.—*C. F. M.*